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EXAMINER

D.U.T.

ART UNIT

PAPER NUMBER

2782

DATE MAILED:

03/28/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/411,698

Applicant(s)

STOLOWITZ, MICHAEL C.

Examiner

Thuan N. Du

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Status

- 1) ☒ Responsive to communication(s) filed on 01 October 1999.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 October 1999 is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some * c) ☐ None of the CERTIFIED copies of the priority documents have been:
1. ☐ received.
2. ☐ received in Application No. (Series Code / Serial Number) _____.
3. ☐ received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

Attachment(s)

- 14) ☒ Notice of References Cited (PTO-892)
- 15) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 16) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 17) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 18) ☐ Notice of Informal Patent Application (PTO-152)
- 19) ☐ Other: _____.

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DETAILED ACTION

1. Claims 1-19 are presented for examination.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "920" has been used to designate both multiplexer and XOR circuit in Fig. 9. Correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

4. Claims 1-4, 6-8, 10-19 are rejected under 35 U.S.C. 102(e) as being anticipated by Searby (U.S. Patent No. 5,765,186).
5. As per claim 1, Searby teaches a method of reading data from a RAID array of disk drives comprising the steps of:

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providing a single buffer memory having a data port coupled to all of the disk drive data ports for transferring digital data [Fig. 2, buffers 37-40. Considering the set of buffers 37-40 is a single bigger buffer with plurality of locations, e.g. locations 37-40];

providing a single address counter for addressing consecutive locations in the buffer memory [col. 7, lines 20-24. Inherently, the controller provides a single address counter for addressing the locations of the buffer stated above];

sending read commands to all of the disk drives so as to initiate read operations in all of the disk drives [col. 6, lines 27-31];

waiting until read data elements are ready at all of the disk drive data ports [col. 6, lines 64-67];

after read data elements are ready at all of the disk drive data ports, synchronously retrieving and storing the read data elements from all of the read drive data ports into consecutive locations in the buffer memory under addressing control of the single address counter [col. 6, line 64 through col. 7, line 10];

wherein said synchronously retrieving and storing the read data elements from all of the read drive data ports includes clocking the read data through a common pipeline so as to form a contiguous word serial data stream through the pipeline [Fig. 3, shift register 57, col. 9, lines 40-42];

concurrently computing redundant data from the read data while the read data moves through the pipeline [col. 9, lines 40-60];

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and, if a failed disk drive has been identified, substituting the computed redundant data into the word serial data stream in lieu of the failed disk drive data [col. 9, lines 50-55]; and storing the word serial data stream into the buffer memory thereby providing the requested read data without incurring delay to reconstruct data stored on the failed disk drive [col. 4, lines 29-44].

6. As per claim 2, Searby teaches the system comprising:

host bus interface means for interfacing to a host bus data transfer [register 50 in Figs. 2, 3 is in the form of host bus interface means];

buffer memory means for storing data [Figs. 2, 3, buffers 37-40];

a processor for controlling operation of the disk controller so as to effect synchronous data transfers between the buffer memory and an array of disk drives [Figs. 2, 3, controller 51];

disk drive interface means including a drive data bus for interfacing the controller to an array of disk drives including a redundant drive [Figs. 2, 3, interfaces 25-28];

redundant data operating means disposed along the drive data bus for forming redundant drive data on the fly as data passes from the buffer memory to the drives during disk write operation [parity generator 55 of Fig. 3 disposed along the drive data bus is in the form of redundant data operating means].

7. As per claim 3, Searby teaches the redundant data operating means includes:

a multiplexer having a first input coupled to the buffer memory port to receive write data [parity generator 55 is in the form of the multiplexer];

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an XOR/LOAD circuit having a first input coupled to the buffer memory port [col. 9, lines 5-8];

an accumulator coupled to the output of the XOR/LOAD circuit [col. 9, lines 8-11];

a feedback path from the accumulator circuit to a second input of the XOR/LOAD circuit [col. 9, lines 15-23];

the multiplexer having a second input coupled to the accumulator [the accumulator is considered same circuit with the multiplexer]; and

the multiplexer output coupled to the drive data bus for interfacing to the array of disk drives, so that in operation the multiplexer selects either a word of write data from the buffer memory for writing to disk, or a redundant word formed in the accumulator for writing to disk as redundant data [col. 9, lines 8-23].

8. As per claim 4, Searby discloses a second redundant data operating means disposed along the drive data bus for reconstructing missing data on the fly [data generator 56 and delay shift register 57 of Fig. 3 disposed along the drive data bus are in the form of redundant data operating means].

9. As per claim 6, Searby teaches the system comprising:

a buffer memory [Figs. 2, 3, buffers 37-40];

disk drive interface means for connection to a plurality of disk drives [Figs. 2, 3, interfaces 25-28];

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control means coupled to the buffer memory and coupled to the data bus for synchronously transferring data over the data bus between the buffer memory and the interface means [controller 51 of Figs. 2, 3, col. 6, line 64 to col. 7, line 1];

means disposed between the buffer memory and the data bus for generating redundant check data on the fly during execution of disk write operation [parity generator 55 of Fig. 3].

10. As per claim 7, Searby teaches the system comprising:

a buffer memory [Figs. 2, 3, buffers 37-40];

disk drive interface means for connection to a plurality of disk drives [Figs. 2, 3, interfaces 25-28];

control means coupled to the buffer memory and coupled to the data bus for synchronously transferring data over the data bus between the buffer memory and the interface means [controller 51 of Figs. 2, 3, col. 6, line 64 to col. 7, line 1];

means disposed between the buffer memory and the drive data bus for reconstructing missing data during a read operation [data generator 56 and delay shift register 57 of Fig. 3].

11. As per claim 8, Searby teaches the reconstructing means includes a pipeline of registers arranged for transferring word serial read data [delay register 57 of Fig. 3, col. 9, lines 48-51].

12. As per claims 10-19, they are the corresponding method steps of claimed apparatus.

Therefore, they are rejected under the same rational.

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Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claims 5, 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searby (U.S. Patent No. 5,765,186).

15. As per claim 5, Searby teaches the second redundant data operating means includes:

a pipeline of register through which read data is passed during a disk read operation [delay shift register 57 of Fig. 3];

an input end of the pipeline coupled to the disk drive data bus to receive read data [Fig. 3];

a multiplexer having a first input coupled to an output end of the pipeline to receive read data [register 50 is also in the form of the multiplexer];

an XOR circuit coupled to the disk drive data bus to receive read data [data generator 56 of Fig. 3, col. 9, lines 42-43];

an accumulator having an input coupled to XOR circuit output [data generator 56 of Fig. 3, col. 9, lines 54-55];

the multiplexer selects either a word of valid read data from the pipeline or a reconstructed word formed in the accumulator in lieu of missing or bad data [col. 9, lines 48-60].

Searby does not explicitly teach:

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a holding circuit having an input coupled to the XOR circuit output;
a holding circuit having an input coupled to the accumulator to hold accumulated data;
a feedback path from the output of the accumulator to a second input of the XOR circuit for forming XOR data in the accumulator as valid read data passes through the XOR circuit from the drive data bus;
an output path from the hold circuit to a second input of the multiplexer to provide reconstructed missing data.

Searby teaches the delay circuit to hold the output data while the calculating of missing data is performing. It would have been obvious to one of ordinary skill in the art to have a hold circuit coupled to the data generating circuit to hold the calculated data before the data input to the multiplexer by the output path of the hold circuit.

16. As per claim 9, Searby does not explicitly teach the pipeline includes a number of stage equal to $N+1$, where N is the total number of disk drives in the array, but it is a matter of design choice to have an additional stage in the pipeline for storing redundant data in read operation.

Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thuan N. Du whose telephone number is (703) 308-6292. The examiner can normally be reached on Monday-Friday: 8:00 am - 4:30 pm.

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18. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas C. Lee can be reached on (703) 305-9717. The fax phone numbers for the organization where this application or proceeding is assigned is (703) 308-3718.

19. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-9000.

Examiner: Thuan N. Du
Date: March 14, 2000



THOMAS C. LEE
SUPERVISORY PATENT EXAMINER
GROUP 2700